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ABSTRACT

The Stanford Achievement Test (SAT), Intermediate Level II, was administered to 11,077 sixth grade students during fall 1984. This two-section report presents findings of the SAT's three mathematics subtests. These subtests measured competency related to: (1) mathematics concepts (number, notation, operations, and geometry/measurement), (2) computation, and (3) applications (story-problem items involving use of proportions, measurement, cost estimation, fractions, graphs, tables, and map reading). Section I, an overview, discusses the purpose of the test, the background of the test administration, and the approach for program analysis; a general summmary of performance is included. Section II provides an overall analysis and an analysis of each subtest relative to task requirement, student performance in Hawaii compared to national performance, implications, and recommendations. Grade 6 SAT item matches (SAT objective correlated with learner objective or performance expectation) and other supporting documentation are included in appendices. The statewide summary of group stanine results indicates that sixth grade students in Hawaii performed better than the national average norm population with 80 percent scoring in the average and above average ranges. This is 3 percent higher than the national norm of 77 percent. (JN)

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MATHEMATICS PROGRAM ANALYSIS OF GRADE 6, STANFORD ACHIEVEMENT TEST, INTERMEDIATE LEVEL II

Fall 1984 Administration

SE 045 875

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FOREWORD

As part of the Department's competency-based thrust, the analysis of test results is being conducted and reported. Performance data from tests and other sources are critical in the educational process and should be used to assist students, improve instruction, and upgrade programs. The efforts to date by teachers, principals and specialists are making significant impact on the achievement of students as indicated by the test results.

Although recent test results indicate overall improvement statewide, it is hoped that each level within the Department will continue to conduct review and analysis of formal data to determine student needs and related intervention activities. The momentum for positive change has begun and should be maintained, if not accelerated, as we work together to provide a solid foundation for all subsequent learning.

Francis M. Hatanaka

Francis M. Hatanaka, Superintendent

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I. OVERVIEW

A. Purpose

The purposes of this report are:

1. To provide information on the effectiveness of the mathematics program in the elementary school, including identification of deficiency areas which require attention and the implications and recommendations for improving instruction towards the goals and objectives of the Foundation Program and Mathematics Education.

2. To provide a model for subsequent district and school analyses.

It is expected that state, district and school level improvement efforts will be directed at the identified deficiency areas.

B. Background of the Test Administration

The Stanford Achievement Test (SAT) has been administered since the mid-1970s to students of grades 2, 4, 6, 8, and 10 as a means of assessing and analyzing student performance in planning program improvement. Beginning school year 1984-85, the SAT will not be administered to grade 4 in the Fall, but rather to grade 3 in the Spring as part of the Competency Based Measures (CBM). For the purpose of this report, the data, analysis and recommendations for improvement will be restricted to the 11,077 students of grade 6 who were tested during the Fall of 1984.

C. Approach for Program Analysis

The following framework guided the program planner for mathematics in the analysis process. With minor modification or changes in focus, the framework may be used by schools or teachers in the assessment of test results for use in instructional planning and delivery.

1. How well does the test measure the program efforts? (Curriculum Validity)

   a. How well does the subtest content (items) reflect the major program emphases?

   b. Are there test items that measure what is <u>not</u> taught until later in the school experience?

   c. Are there major emphases for grade 6 that are <u>not</u> measured by this test?

2. How are the students performing? (Student Achievement)

   a. How well are the students doing statewide?

   b. Are there variations among subtest areas?

c. Are variations what would have been expected? If so, why?

d. Are variations consistent across all seven districts?

Each subtest was analyzed according to task description, student performance, implications for program/instruction, and recommendations for improvement.

D. General Summary of Performance

The statewide summary of group stanine results indicates that sixth grade students in Hawaii performed better than the national norm population with 80% scoring in the average and above average ranges. This is 3% higher than the national norm (77%).

	Below Average %	Average %	Above Average %
National	23	54	23
Hawaii's 6th Graders	20	54	26

GRADE 6 ADMINISTRATION

A. Overall Analysis

The Stanford Achievement Test (SAT), Intermediate Level II, includes three subtests related to the area of mathematics: Mathematics Concepts, Mathematics Computation, and Mathematics Applications.

1. Curriculum Validity

The curriculum validity of the test is determined by comparing the test items with the Grade 6 Foundation Program Performance Expectations and Grade 5 learner objectives of the Mathematics Program Guide. Although students are in the sixth grade, the test is administered early in the Fall and measures achievement up to the end of the fifth grade. Analysis of the SAT indicates that the test is moderately effective in assessing the attainment of the goals, objectives, and performance expectations of the State Mathematics Program. There are 16 performance expectations of Foundation Program Objective I: Develop basic skills for learning and effective communication with others. The test does not measure five performance expectations in the areas of decimal computation, geometry, measurement, and making graphs and tables. Another six performance expectations are only partially measured. Still another performance expectation is measured by only one item.

The problem-solving process is a major goal of the mathematics program as well as of the Foundation Program (Foundation Program Objective III: Develop decision-making and problem-solving skills). There are eight performance expectations of which the SAT addresses two. Each performance expectation is measured by only one item.

Approximately 18% of the items measure expectations which are not included in the State Mathematics Program or which may require performance at a level beyond grade 6.

2. Student Performance

The results (see Figure 1) indicate that the sixth grade students in Hawaii scored better than the national norm population on two subtests. Students scored higher in Mathematics Computation and Concepts than in Mathematics Applications. A comparison of the 1983 and 1984 results reveals the following:

a. There is no significant change in the number right and scaled scores for all three subtests. The scaled scores are based upon the raw scores. Scaled scores enable the interpreter to compare from grade to grade, battery to battery, and form to form, the scores within a single test area. Scaled scores are not comparable from one test area to another.

b. A review of the stanine distributions indicates:

1) Within the Mathematics Concepts subtest, the 1984 results are 1% higher than the 1983 results. The percent of students scoring in the average and above average ranges (84%) is higher than the percent of students in the nation (77%) scoring in the same ranges.

2) Within the Mathematics Computation subtest, the 1984 results are the same as the 1983 results. The percent of students in Hawaii scoring in the average and above average ranges (84%) is higher than the percent of students in the nation (77%) scoring in the same ranges.

3) Within the Mathematics Applications subtest, the 1984 results are 1% higher than the 1983 results. The percent of students in Hawaii scoring in the average and above average ranges (75%) is lower than the percent of students in the nation (77%) scoring in the same ranges.

	Mean Scores						Stanine Distribution								
	Number Right			Scaled Scores			Below 1 2 3			Average 4 5 6			Above 7 8 9		
Subtest	Norm	'83	'84	Norm	'83	'84	Norm	'83	'84	Norm	'83	'84	Norm	'83	'84
Concepts	20	20	20	170	170	170	23	17	16	54	53	54	23	30	30
Computation	24	26	26	169	171	171	23	16	16	54	57	59	23	27	25
Applications	24	22	23	167	164	164	23	26	25	54	54	55	23	20	20

Figure 1

3. Implications

Although sixth grade students perform as well as or better than the norm population of the test in two subtest areas, program improvement should continue in all areas.

4. Recommendations

Analysis should be made of each of the subtests to identify those items students did not perform well on. Comparison of these items with the performance expectations should be made, reasons for student performance should be determined, and improvement strategies should be implemented where appropriate. Although the problem-solving process is not tested fully in the Applications subtest, a priority should be placed on the instructional delivery of the problem-solving process and development of logical thinking skills to improve overall mathematics performance.

B. Subtest Analysis

The following is an analysis of each subtest relative to the task requirement, student performance in Hawaii as compared to national performance, implications, and recommendations. The student performance comparison is made with respect to the mean p-values in each of the item-grouping areas (each subtest is divided into three or four groups in which the test items are closely related). The p-value, which gives the percent of students answering the problems correctly, is used to determine what students may need help with. A comparison of local p-values with those of the national norm is used in discussing the implications which are drawn from the relationship of performance expectations with the SAT item objectives.

Further study within each of the item-group areas is made for those areas in which the local p-value is lower than the national p-value. Each item with a lower p-value is listed, but only those items considered significantly lower* are discussed in the section on implications. Thus, the sections on implications and recommendations will deal primarily with identifying areas for program improvement.

1. Mathematics Concepts

a. Description of Task

The subtest consists of 35 items which require the student to read each item and select an answer from four options. Item groupings are in four areas: 1) number, 2) notation, 3) operations, and 4) geometry and measurement.

b. Student Performance

The chart below compares the local and national mean p-values in each item-grouping area. The results show that students in the State of Hawaii scored slightly higher in all areas except in operations. A comparison between the 1983 and 1984 results shows a slight decrease in all areas except geometry and measurement.

	Local %		National %	Difference	
	1983	1984		1983	1984
Number	57	57	55	+2	+2
Notation	61	61	56	+5	+5
Operations	64	63	64	-0-	-0-
Geometry, measurement	55	54	50	+5	+4

Figure 2

*Items with local p-values at least 4 percentage points lower than the national norm are considered significantly low.

Item analysis indicates that the test objectives where students scored lower were as follows:

1) Number

   a) Subtracts in the finite system of a clock module (item 20*).

   b) Determines number of units on number line (item 34).

2) Notation

   a) Identifies numeral expressed in expanded notation (item 6).

   b) Identifies digits that are in the specified period of a given numeral (item 8*).

   c) Identifies another name for given numeral represented in exponential form (item 35*).

3) Operations

   a) Chooses number sentence which describes given operation (item 7).

   b) Identifies division as inverse of multiplication (item 14*).

   c) Chooses term which illustrates that division is distributed over addition (item 25*).

4) Geometry and Measurement

   a) Identifies missing number in ordered pair (item 3*).

   b) Identifies number of empty set (item 4*).

   c) Solves problem in elementary logic (item 15).

   d) Solves problem in elementary logic, using Venn diagrams (item 30).

Specific items in each of the above areas where students scored significantly lower were items 3, 4, 8, 14, 20, 25, and 35. The p-values for these items were also significantly lower in 1983.

c. Implications

Although overall student performance was slightly higher than the national norm, sixth grade students of Hawaii did not do as well as the norm group on specific items that require 1) subtracting in the finite system of a clock module, 2) identifying digits that are in a

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*P-value is significantly lower than the national p-value.

specified period of a given numeral, 3) identifying another name for a given numeral expressed in exponential form, 4) identifying division as the inverse of multiplication, 5) choosing a term which illustrates that division is distributed over addition, 6) identifying the missing number of an ordered pair, and 7) identifying the number of the empty set.

Students may have had difficulty with the items dealing with exponents, the multiplicative inverse, ordered pairs, empty set, and the distributive property of division over addition since these measure concepts students are expected to have in later grades. However, identifying digits of a specified period and determining the number of hours which have lapsed between two specified times are concepts students are expected to have had by the end of the fifth grade.

d. Recommendations

Continue to pursue the performance expectations with a closer look at the related learner objectives that deal with place value and computing measurements of time. Reasons should be determined for students' performance, priorities should be set, and work should begin towards improvement.

2. Mathematics Computation

a. Description of Task

The subtest consists of 45 items. Items 1-24 consist of number sentences which must be completed by the appropriate symbol ($>$, $<$, or $=$).

Items 25-45 are computation algorithms, with five answer otions including the NH (not here) option. Problems involve addition and subtraction of two, three, and four-digit numerals; multiplication with as many as three-digit multipliers; and division with one and two-digit divisors.

Item groupings are in four areas: 1) knowledge of primary facts and solution of simple mathematical sentences, 2) addition and subtraction algorithms, 3) multiplication and division algorithms, and 4) common fractions.

b. Student Performance

The chart below compares local and national p-values in the item groups. The results show that the students in Hawaii scored higher in all areas, except common fractions. These results are very similar to those of the previous year. Slight decreases are reflected in all areas.

	Local %		National %	Difference	
	1983	1984		1983	1984
Knowledge of primary facts and solution of simple mathematical sentences	63	62	61	+2	+1
Addition and Subtraction Algorithms	61	60	54	+7	+6
Multiplication and Division Algorithms	52	51	46	+6	+5
Common Fractions	41	40	41	-0-	-1

Figure 3

Item analysis indicates that test objectives where students scored lower were as follows:

1) Knowledge of primary facts and solution of simple mathematical sentences.

   a) Recognizes numeral distributed into two factors (items 8* and 20*).

   b) Compares values of two common fractions with equal numerators (item 17*).

   c) Renames improper fractions as mixed numerals (item 18*).

   d) Compares two fractional representations of a whole number (item 19*).

   e) Simplifies expression within parentheses before performing any other operation (item 21).

   f) Simplifies expression within parentheses before multiplying (item 15).

*P-value is significantly lower than the national p-value.

2) Multiplication and division algorithms

a) Divides two-digit numeral by one-digit divisor and obtains quotient with remainder (item 44).

3) Common fractions

a) Finds unit fraction of a multiple of the denominator (item 30*).

b) Adds two fractions which have common denominator and sum greater than one (item 42).

Specific items in each of the above areas where students scored significantly lower were items 8, 17-20, and 30. The p-values for these items were also significantly lower in 1983.

c. Implications

Although overall student performance was slightly higher than the national norm, sixth grade students of Hawaii did not do as well as the norm group on specific items that require:

1) recognizing the numeral distributed into two factors,

2) comparing values of two fractions with equal numerators,

3) renaming improper fractions as mixed numerals,

4) comparing two fractional representations of a whole number, and

5) finding the unit fraction of a multiple of the denominator.

Comparing values of two common fractions with equal numerators, renaming improper fractions as mixed numerals, and comparing fractional representations of whole numbers are expectations students should have met by the end of the fifth grade. However, recognizing numerals distributed into two factors and finding the unit fraction are expectations of students by the end of the sixth grade.

d. Recommendations

Continue to pursue the performance expectations with a focus on the instructional strategies related to the specific learner objectives that address comparing and renaming fractions. Program improvement

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*P-value is significantly lower than the national p-value.

may include providing students with more experiences using fractions as well as providing teachers with the instructional strategies to teach concepts and skills in this area. In addition, analyses of amount of time spent and textbook coverage of these areas should be made to determine reasons for students' low performance.

3. Mathematics Applications

a. Description of Task

The subtest consists of 40 story-problem items involving use of proportions; measurement; cost estimation; fractions; and graph, table, and map reading. There are five answer options, not all containing the NH option. Item groupings are in five areas: 1) selection of appropriate operation, 2) analysis and development of a solution design, 3) rate and scale problems, 4) measurement, and 5) graph reading and interpretation.

b. Student Performance

The chart below compares local and national mean p-values in the item-grouping areas. The results show that students in the State of Hawaii scored lower in all areas except in graph reading and interpretation. These results are the same as those of the previous year.

	Local %		National %	Difference	
	1983	1984		1983	1984
Selection of appropriate operation	75	75	80	-5	-5
Analysis and development of a solution design	55	55	57	-2	-2
Rate and scale	53	53	57	-4	-4
Measurement	39	39	42	-3	-3
Graph reading and interpretation	56	56	55	+1	+1

Figure 4

Item analysis indicates that almost all of the test objectives had lower p-values, except for those items requiring 1) adding and subtracting in two-step sequence, 2) rounding prices to estimate total price, 3) determining correct change, 4) determining additional information, 5) determining percent of figure shaded, 6) adding measures of time, 7) finding area of a region, 8) finding differences between dates on a table, and 9) using bar graph to determine specific information and to make comparisons.

Items where p-values were significantly lower were:

1) Selection of appropriate operation

   a) Dividing to find number of equal units (items 7 and 11).

   b) Dividing to find "how many" of unit number (item 9).

   c) Finding total number of objects expressed in different measures of quantity (item 12).

2) Analysis and development of solution design

   a) Multiplying and adding in two-step sequence (item 13).

   b) Rounding price of item and estimating price for a number of items (16).

   c) Multiplying and subtracting in two-step sequence (item 32).

   d) Translating verbal problem into a mathematical sentence (item 23).

3) Rate and scale problems

   a) Determining specific rate (items 1 and 19).

   b) Finding unit fraction of a number (item 24).

   c) Interpreting map scale to determine relative distances (item 34).

   d) Expressing part of total as a fraction (item 36).

   e) Determining a specific rate based upon an average (item 3).

4) Measurement

   a) Converting standard units of linear measure (item 30).

   b) Converting standard units of liquid measure (item 38).

   c) Subtracting two measures and converting into another unit of measure (item 40).

5) Graph reading and interpretation

   a) Using bar graph to combine frequencies (item 29).

The p-values for all of these items, except items 3 and 23 were also significantly lower in 1983.

c. Implications

All of the items above, except items 23, 24, 30, 38, and 40 are related to performance expectations or learner objectives that students should have met by the end of the fifth grade. Items 24, 30, 38, and 40 measure performance expectations or learner objectives of the sixth grade or later. Translating verbal problems into mathematical sentences (item 23) is not a specific objective of the mathematics program.

Items students were expected to do better on involved the use of the four algorithms (addition, subtraction, multiplication, and division), measurement, proportion, fractions, cost estimation, and graph reading and interpretation. Since students tended to do well in the Computation subtest, it may not be lack of a specific computational skill that is the cause of error, but inexperience in applying the problem-solving process. However, the specific area of computing with fractions was low in both of the Computation and Applications subtests, and should be a focus of program improvement.

d. Recommendations

Continue to pursue the performance expectations of the Mathematics Program. Reasons should be determined for students' low performance and work should begin towards improvement. Program improvement may include providing students with more experiences involving computing with fractions and problem-solving strategies. There are elementary programs which address problem solving in consonance with the Mathematics Program Guide. Some of these programs such as the Curriculum Development Associates (CDA) Mathematics and Comprehensive School Mathematics Program (CSMP) are being implemented in several schools. Schools will need to determine if these and other commercial programs that emphasize problem solving can be used to meet their needs as alternatives to their existing mathematics program.

The Mathematics Program Guide also provides direction in identifying problem-solving behaviors and strategies for teaching. Schools should investigate to see how these strategies may be used for teaching problem solving within their on-going program. Schools should also look at the available in-service workshops which address this need, and encourage their teachers to participate.

APPENDIX

Appendix A

Grade 6 SAT
Item Matches

CONCEPTS

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
1	Identifies the place value of a digit in a given numeral.	Reads, writes, and orally names numerals to 1,000,000 and identifies the place value of each digit.	5 LO
2	Identifies the missing terms in a number sentence which illustrates the associative property of addition.	Adds 3 or more numbers with sums of 18 or less.	2 LO
3	Identies the missing number in an ordered pair.	Recognizes patterns for a set of numbers.	7-8 LO
4	Identifies the number of the empty set.	No match.	
5	Chooses the number which belongs to a given number series.	Recognizes patterns for a set of numbers.	7-8 LO
6	Identifies the numeral expressed in expanded notation.	Writes numerals in expanded and exponential notation.	7-8 LO
7	Chooses the number sentence which describes a given operation.	Uses algebraic techniques and describes their relationship to the properties of the real numbers.	8 PE
8	Identifies the digits that are in a specified period of a given number.	Reads, writes, and orally names numerals to 1,000,000 and identifies the place value of each digit.	5 LO
9	Identifies the number which is one hundred greater than a given number.	Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
10	Determines what percent of a region is shaded.	Understands that percent is a special ratio, namely 1 to 100, and may be symbolized as 1/100, .01, or 1%.	6 LO
		Solves simple ratio, proportion, and percent problems.	6 PE
11	Distinguishes a quadrilateral from another geometric shape.	Sorts polygons by observing similarities and differences in their properties, describes common features of figures in each class using different classifications.	5 LO
		Identifies and compares plane and solid geometric figures in the environment.	3 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
		Sorts plane and solid geometric figures according to their observed properties.	3 PE
12	Selects a set consisting only of odd numbers.	Discovers special arrangements of objects for even and odd numbers.	2 LO
13	Chooses a number sentence which explains the multiplicative identity.	Uses algebraic techniques and describes their relationship to the properties of the real numbers.	8 PE
14	Identifies division as the inverse of multiplication.	No match. The term inverse is not used although the relationship of multiplication and division is an objective in Grade 3.	
15	Solves a problem in elementary logic.	Makes inferences for each alternative and selects a solution based on information collected.	FPO III 3 PE 6 PE
16	Chooses a triangle which is similar to a given triangle.	Sorts geometric figures into sets of similar ones.	4 LO
		Explains relationships of the parts of a geometric figure and relationships among geometric figures.	8 PE
17	Translates a word form of a given number into its Arabic numeral.	No match.	
18	Selects the second factor of a given number when one factor is given.	Investigates multiples and factors of a number; expresses a number as a multiple of some number; and expresses a number as a product of factors.	5 LO
19	Determines what fractional part of an area is shaded.	Uses ratios to compare quantities and measurements of objects.	6 PE
20	Subtracts in the finite system of a clock module.	Compares measurements of time.	4 LO
		Measures, reads, and compares lengths, temperatures, masses, capacity, times of events, and quantities of money.	3 PE
21	Identifies a line segment.	Identifies, names, and draws various plane and solid geometric figures.	3 PE
22	Identifies a fraction which is equivalent to a given fraction.	Finds equivalent fractions in a variety of ways.	4 LO
23	Determines the measurement of the shaded area of a rectangular figure.	Finds areas of regions by using different types of grids.	4 LO

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
24	Selects the number line graph of a defined set of numbers.	Interprets data given in a line graph.	5 LO
25	Chooses a term which illustrates that division is distributed over addition.	Generalizes properties of numbers.	7-8 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
26	Recognizes the description of a line segment.	Uses correct terminology in describing the properties of geometric figures.	6 PE
27	Rounds a given number to the nearest hundred.	Rounds to the nearest thousand.	4 LO
28	Identifies two disjoint sets.	No match.	
29	Chooses a figure which has a right angle.	Locates examples of angles, forms angles and tests for right angles.	3 LO
		Sorts plane and solid geometric figures according to their observed properties.	3 PE
30	Solves a problem in elementary logic, using Venn diagrams.	No match.	
31	Estimates a product to the nearest hundred.	Rounds to the nearest thousand.	4 LO
		Estimates measurements and does arithmetic mentally.	3 PE 6 PE
32	Estimates the distance between two points, in metric units.	Locates distances and/or objects in the environment that have lengths about a kilometer, a meter, a decimeter, and a centimeter.	5 LO
		Estimates measurements and does arithmetic mentally.	3 PE 6 PE
		Estimates and measures length, capacity, and mass (weight) of objects using standard units.	6 PE
33	Identifies a prime number.	Investigates characteristics of prime and composite numbers and classifies number less than 50 as prime or composite.	5 LO

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
34	Determines the number of units from one point to another on a number line.	Finds the opposite of, adds, subtracts, multiplies, and divides integers.	Alg. IA
		Adds, subtracts, multiplies, and divides fractions and integers.	8 PE
35	Identifies another name for a given numeral represented in exponential form.	Writes numerals in expanded and exponential notation.	7-8 LO
COMPUTATION			
1	Derives two addition facts.	Discovers and then memorizes addition and subtraction facts through sums of 18.	2 LO
		Recalls addition and subtraction facts through sums of 18.	2 PE
2	Derives two addition facts.	Discovers and then memorizes addition and subtraction facts through sums of 18.	2 LO
		Recalls addition and subtraction facts through sums of 18.	2 PE
3	Derives two addition facts.	Discovers and then memorizes addition and subtraction facts through sums of 18.	2 LO
		Recalls addition and subtraction facts through sums of 18.	2 PE
4	Derives two subtraction facts.	Discovers and then memorizes addition and subtraction facts through sums of 18.	2 LO
		Recalls addition and subtraction facts through sums of 18.	2 PE
5	Derives two subtraction facts.	Discovers and then memorizes addition and subtraction facts through sums of 18.	2 LO
		Recalls addition and subtraction facts through sums of 18.	2 PE
6	Derives two multiplication facts.	Uses basic multiplication facts to corresponding division facts through products of 81.	3 LO
		Recalls multiplication and division facts through products of 81.	3 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
7	Multiplies within parentheses and then adds.	Computes multi-operational problems by applying the rule for the order of operation.	7-8 LO
		Adds and subtracts 3-digit numbers with regrouping (carrying and borrowing).	3 PE
		Recalls multiplication and division facts through products of 81.	3 PE
8	Recognizes a numeral distributed into two factors.	Computes multi-operational problems by applying the rule for the order of operation.	7-8 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
9	Relates two products with a common factor and an unequal second factor.	Computes multi-operational problems by applying the rule for the order of operation.	7-8 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
10	Derives two division facts.	Uses basic multiplication facts and corresponding division facts through products of 81.	3 LO
		Recalls multiplication and division facts through products of 81.	3 PE
11	Derives two division facts with remainders.	Divides with 1-digit divisor and quotient three digits or less.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
12	Derives two division facts with remainders.	Divides with 1-digit divisor and quotient three digits or less.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
13	Multiplies a three-digit factor with a medial zero by a one-digit factor.	Finds the product of all whole numbers.	5 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
14	Multiplies a three-digit factor with a medial zero by a one-digit factor.	Finds the product of all whole numbers.	5 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
15	Simplifies the expression within the parentheses before multiplying.	Computes multi-operational problems by applying the rule for the order of operation.	7-8 LO
		Recalls addition and subtraction facts through sums of 18.	2 PE
		Discovers and then memorizes addition and subtraction facts through sums of 18.	2 LO
		Recalls multiplication and division facts through products of 81.	3 PE
		Uses basic multiplication facts to corresponding division facts through products of 81.	3 LO
16	Adds two unit fractions with different denominators.	Adds and subtracts commonly used fractions and mixed numbers with unlike denominators.	6 LO
		Adds and subtracts commonly-used fractions (mixed and common) with unlike denominators.	6 PE
17	Compares the values of the two common fractions with equal numerators.	Orders fractions from least to greatest using "<" and ">".	5 LO
18	Renames improper fractions as "mixed numerals."	Orders fractions from least to greatest using "<" and ">".	5 LO
19	Compares two fractional representations of a whole number.	Orders fractions from least to greatest using "<" and ">".	5 LO

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
20	Recognizes a numeral distributed into two factors.	Computes multi-operational problems by applying the rule for the order of operation.	7-8 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
21	Simplifies the expression within the parentheses before performing any other operation.	Computes multi-operational problems by applying the rule for the order of operation.	7-8 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
22	Compares the value of a decimal fraction with a common fraction.	Expresses fraction as decimals to hundredths.	5 LO
23	Simplifies the expression within the parentheses before multiplying.	Computes multi-operational problems by applying the rule for the order of operation.	7-8 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
24	Simplifies the expression within the parentheses before subtracting.	Computes multi-operational problems by applying the rule for the order of operation.	7-8 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
25	Multiplies a two-digit numberal by a one-digit multiplier and renames ones.	Multiplies with one factor less than 100 and the other factor less than 10.	3 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
26	Finds the value of a sentence placeholder by subtracting.	Uses algebraic techniques and describes their relationship to the properties of the real numbers.	8 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
27	Subtracts a three-digit subtrahend from a three-digit minuend, and renames tens and hundreds in a problem which involves a disappearing left digit.	Adds and subtracts two 3-digit numbers with regrouping.	3 LO
		Adds and subtracts 3-digit numbers with regrouping (carrying and borrowing).	3 PE
28	Divides a three-digit numeral by a one-digit divisor and renames tens.	Divides with a 1-digit divisor and quotient three digits or less.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
29	Divides a three-digit numeral by a one-digit divisor and renames tens.	Divides with a 1-digit divisor and quotient three digits or less.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
30	Finds a unit fraction of a multiple of the denominator.	Adds, subtracts, multiplies, and divides fractions and mixed numbers.	7-8 LO
		Multiplies and divides mixed and common fractions.	6 PE
31	Divides a two-digit numeral by a two-digit divisor.	Divides by two-digit divisors and expresses the quotient as a mixed number.	5 LO
32	Adds a broken column of four addends with renaming.	Shows proficiency in adding and subtracting whole numbers.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
33	Subtracts a three-digit subtrahend from a four-digit minuend, and renames tens and hundreds in a problem which involves a disappearing left digit.	Shows proficiency in adding and subtracting whole numbers.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
34	Adds two fractions which have a common denominator and a sum less than one.	Adds and subtracts fractions having like denominators.	4 LO
		Adds and subtracts like-denominator fractions and commonly used decimals.	6 PE
35	Multiplies a three-digit numeral by a two-digit multiplier with a zero in the multiplicand and renames ones and tens.	Multiplies with two-digit multipliers.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
36	Multiplies a three-digit numeral by a two-digit multiplier and renames ones and tens.	Multiplies with two-digit multipliers.	4 LO
		Adds and subtracts whole numbes; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
37	Finds the minuend in a horizontal algorithm when the subtrahend and remainder are known.	Shows proficiency in adding and subtracting whole numbers.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
38	Estimates the value of the quotient when the dividend and divisor are known.	Divides by two-digit divisors and expresses the quotient as a mixed number.	5 LO
		Estimates by rounding.	4 LO
39	Subtracts a four-digit subtrahend from a five-digit minuend, with a zero in the minuend and renaming in all positions.	Shows proficiency in adding and subtracting whole numbers.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
40	Multiplies two three-digit numerals, with a zero in the ones position of the multiplier and renaming.	Finds the product of all whole numbers.	5 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
41	Multiplies a three-digit numeral by a two-digit multiplier with renaming.	Multiplies with two-digit multipliers.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divdes any whole number by a 1-digit number.	6 PE
42	Adds two fractions which have a common denominator and a sum greater than one.	Adds and subtracts fractions having like denominators.	4 LO
		Adds and subtracts like-denominator fractions and commonly used decimals.	6 PE
43	Divides a four-digit numeral by a one-digit divisor and obtains a quotient with a zero in the tens place.	Divides with a 1-digit divisor and quotient three digits or less.	4 LO
		Adds and subtracts whole numbers; multiplies any whole number by a 2-digit number; and divides any whole number by a 1-digit number.	6 PE
44	Divides a two-digit numeral by a one-digit divisor and obtains a quotient with a remainder.	Divides with one-digit divisors having one or two-digit quotients.	3 LO
		Multiplies and divides 2-digit numbers by 1-digit numbers.	3 PE
45	Finds the least common denominator for three fractions with unlike denominators.	Adds and subtracts commonly-used fractions (mixed and common) with unlike denominators.	6 PE
APPLICATIONS			
1	Determining a specific rate.	Uses basic multiplication facts and corresponding division facts through products of 81.	3 LO
		Solves simple ratio, proportion, and percent problems.	6 PE
2	Determining a specific rate.	Searches for and finds ways of obtaining ratios equal to a given ratio.	5 LO
		Solves simple ratio, proportion, and percent problems.	6 PE
3	Determining a specific rate based upon an average.	Searches for and finds ways of obtaining ratios equal to a given ratio.	5 LO
		Solves simple ratio, proportion, and percent problems.	6 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
4	Determining a specific rate by division.	Uses operations of multiplication and division involing money expressions.	5 LO
		Solves simple ratio, proportion, and percent problems.	6 PE
5	Subtracting to find a remainder.	Discovers and then memorizes addition and subtraction facts through sums of 18.	2 LO
		Recalls the addition and subtraction facts through sums of 18.	2 PE
6	Adding and subtracting in a two-step sequence.	Groups materials and records results for addition and subtraction with carrying and borrowing for two-digit numbers, then performs the algorithm without the use of objects.	2 LO
		Adds and subtracts through 3-digit numbers with regrouping (carrying and borrowing).	2 PE
7	Dividing to find a number of equal units.	Uses basic multiplication facts and corresponding division facts through products of 81.	3 LO
		Recalls multiplication and division facts through products of 81.	3 PE
8	Adding and subtracting in a two-step sequence.	Uses operations of addition and subtraction involving money expression.	4 LO
		Measures and computes measurements using the four basic operations.	6 PE
9	Dividing in order to find "how many" of a unit number.	Uses operations of multiplication and division involving money expressions.	5 LO
10	Determining a rate per unit of time by multiplication.	Multiplies numbers by multiples of 10 and 100.	4 LO
		Solves simple ratio, proportion, and percent problems.	6 PE
11	Dividing to find a number of equal units.	Uses basic multiplication facts and corresponding division facts through products of 81.	3 LO
		Solves simple ratio, proportion, and percent problems.	6 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
12	Finding the total number of objects which are expressed in different measures of quantity.	Groups materials and records results for addition and subtraction with carrying and borrowing for two-digit numbers, then performs the algorithm without the use of objects. (Key vocabulary to this item are dozen and pair.)	2 LO
		Adds and subtracts through 3-digit numbers with regrouping (carrying and borrowing).	2 PE
13	Multiplying and adding in a two-step sequence.	Uses operations of multiplication and division involving money expressions.	5 LO
		Measures and computes measurements using the four basic operations.	6 PE
14	Finding the difference between two dates in a table.	Extends ability to read, interpret, and make graphs and tables.	7-8 L
		Compares measurements of time.	4 LO
		Makes, reads, and interprets tables and commonly-used schedules.	6 PE
15	Finding the difference between two dates in a table.	Extends ability to read, interpret, and make graphs and tables.	7-8 L
		Compares measurements of time.	4 LO
		Makes, reads, and interprets tables and commonly-used schedules.	6 PE
16	Rounding the price of an item and estimating the price for a number of items.	Rounds decimals to the nearest tenth, nearest whole number, nearest hundredths, or nearest thousandths.	5 LO
		Uses operations of multiplication and division involing money expressions.	5 LO
		Measures and computes measurements using the four basic operations.	6 PE
17	Translating the verbal problem into a mathematical sentence.	No match.	
18	Rounding three prices to estimate a total price.	Rounds decimals to the nearest tenth, nearest whole number, nearest hundredth, or nearest thousandth.	5 LO
		Uses operations of addition and subtraction involving money expressions.	4 LO
		Measures and computes measurements using the four basic operations.	6 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
19	Determining a specific rate.	Uses operations of multiplication and division involving money expressions. (Students will need to know the meaning of dozen.)	5 LO
		Solves simple ratio, proportion, and percent problems.	6 PE
20	Finding a unit fraction of a number.	Adds and subtracts through 3-digit numbers with regrouping (carrying and borrowing).	2 PE
		Uses ratios to compare quantities and measurements of objects.	6 PE
		Solves simple ratio, proportion, and percent problems.	6 PE
21	Translating a verbal problem into a mathematical sentence.	No match.	
22	Adding times expressed in hours and minutes.	Computes with numbers which have been derived from different measurements of time.	5 LO
		Measures and computes measurements using the four basic operations.	6 PE
23	Translating a verbal problem into a mathematical sentence.	No match.	
24	Finding a unit fraction of a number.	Adds, subtracts, multiplies, and divides fractions and mixed numbers.	7-8 LO
		Multiplies and divides mixed and common fractions.	6 PE
25	Determining correct change by adding and subtracting.	Uses operations of addition and subtraction involving money expressions.	4 LO
		Makes change through five dollars.	4 LO
		Measures and computes measurements using the four basic operations.	6 PE
26	Determining what additional information is needed.	Asks appropriate questions to identify and clarify a problem and determines the information needed to solve the problem.	FPO III 6 PE
27	Using a bar graph to determine specific information.	Interprets data given in bar graphs.	2 LO
		Orders numbers to 100,000.	4 LO

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
28	Using a bar graph to make a comparison.	Interprets data given in bar graphs.	2 LO
		Estimates sums and unknown addends by rounding or by performing two steps.	4 LO
		Estimates measurements and does arithmetic mentally.	6 PE
29	Using a bar graph to combine frequencies.	Interprets data given in bar graphs.	2 LO
		Estimates sums and unknown addends by rounding or by performing two steps.	4 LO
		Estimates measurements and does arithmetic mentally.	6 PE
30	Converting standard units of linear measure.	Measures and computes measurements using the four basic operations.	6 PE
31	Finding 50% of an amount of money.	Solves percent problems.	7-8
		Solves simple ratio, proportion, and percent problems.	6 PE
32	Multiplying and subtracting in a two-step sequence.	Multiplies 2-digit numbers by 1-digit numbers without regrouping.	3 PE
		Adds and subtracts 3-digit numbers with regrouping (carrying and borrowing).	3 PE
33	Finding a total when a part of its fractional representation of the whole is known.	Uses ratios to compare quantities and measurements of objects.	6 PE
		Solves simple ratio, proportion, and percent problems.	6 PE
34	Interpreting a map scale to determine relative distances.	Searches for and finds ways of obtaining ratios equal to a given ratio.	5 LO
		Solves simple ratio, proportion, and percent problems.	6 PE
35	Finding the area of a region.	Finds areas of regions by using different types of grids.	4 LO
36	Expressing a part of the total as a fraction.	Reads and writes common and mixed fractions.	4 LO
		Investigates ways to express fractions in lowest terms.	5 LO
		Uses ratios to compare quantities and measurements of objects.	6 PE

Item #	SAT Objective	Learner Objective (LO) or Performance Expectation (PE)	Grade
37	Determining what percent of a figure is shaded.	Solves percent problems.	7-8 LO
		Solves simple ratio, proportion, and percent problems.	6 PE
38	Converting standard units of liquid measure.	Making, reads, and interprets tables and commonly-used schedules.	6 PE
39	Determining and analyzing a specific rate.	Searches for and finds ways of obtaining ratios equal to a given ratio.	5 LO
		Uses ratios to compare quantities and measurements of objects.	6 PE
		Solves simple ratio, proportion, and percent problems.	6 PE
40	Subtracting two measures and converting into another unit of measure.	Measures and computes measurements using the four basic operations.	6 PE

Appendix B

Items Not Matched to Grade 6 PEs
and Gr. 5 Learner Objectives

	Item #	Description	Grade PE/LO
Concepts	2	Identifies the missing terms in a number sentence which illustrates the associative property of addition.	2 LO
	3	Identifies the missing number in an ordered pair.	7-8 LO
	4	Identifies the number of the empty set.	-
	5	Chooses the number which belongs to a given number series.	7-8 LO
	6	Identifies the numeral expressed in expanded notation.	7-8 LO
	7	Chooses the number sentence which describes a given operation.	8 PE
	12	Selects a set consisting only of odd numbers.	2 LO
	13	Chooses a number sentence which explains the multiplicative identity.	8 PE
	14	Identifies division as the inverse of multiplication.	-
	16	Chooses a triangle which is similar to a given triangle.	4 LO
	17	Translates a word form of a given number into its Arabic numeral.	-
	20	Subtracts in the finite system of a clock module.	3 PE
	21	Identifies a line segment.	3 PE
	22	Identifies a fraction which is equivalent to a given fraction.	4 LO
	23	Determines the measurement of the shaded area of a rectangular figure.	4 LO
	27	Rounds a given number to the nearest hundred.	4 LO
	28	Identifies two disjoint sets.	-
	29	Chooses a figure which has a right angle.	3 PE
	30	Solves a problem in elementary logic, using Venn diagrams.	-
	34	Determines the number of units from one point to another on a number line.	8 PE

35	Identifies another name for a given numeral represented in exponential form.	7-8 LO
Computation		
1	Derives two addition facts.	2 PE
2	Derives two addition facts.	2 PE
3	Derives two addition facts.	2 PE
4	Derives two subtraction facts.	2 PE
5	Derives two subtraction facts.	2 PE
6	Derives two multiplication facts.	3 PE
7	Multiplies within parentheses and then adds.	7-8 LO
10	Derives two division facts.	3 PE
15	Simplifies the expression within the parentheses before multiplying.	7-8 LO
21	Simplifies the expression within the parentheses before performing any other operation.	7-8 LO
23	Simplifies the expression within the parentheses before multiplying.	7-8 LO
24	Simplifies the expression within the parentheses before subtracting.	7-8 LO
26	Finds the value of a sentence placeholder by subtracting.	8 PE
27	Subtracts a three-digit subtrahend from a three-digit minuend, and renames tens and hundreds in a problem which involves a disappearing left digit.	3 PE
44	Divides a two-digit numeral by a one-digit divisor and obtains a quotient with a remainder.	3 PE
Applications		
5	Subtracting to find a remainder.	2 PE
6	Adding and subtracting in a two-step sequence.	2 PE
7	Dividing to find a number of equal units.	3 PE
12	Finding the total number of objects which are expressed in different measures of quantity.	2 PE
17	Translating the verbal problem into a mathematical sentence.	-

21	Translating a verbal problem into a mathematical sentence.	-
23	Translating a verbal problem into a mathematical sentence.	-
27	Using a bar graph to determine specific information.	2 LO
32	Multiplying and subtracting in a two-step sequence.	3 PE
35	Finding the area of a region.	4 LO

Appendix C

Grade 6 PES Not Addressed

Performance Expectation	Comments
Adds and subtracts like-denominator fractions and commonly-used decimals.	Partial match by 2 items.
Multiplies and divides decimals.	No match.
Adds and subtracts commonly-used fractions (mixed and common) with unlike denominators.	Partial match by 2 items.
Multiplies and divides mixed and common fractions.	Partial match by 2 items.
Estimates and measures length, capacity, and mass (weight) of objects using standard units.	Partial match by 1 item.
Measures and computes measurements using the four basic operations.	Partial match.
Explains the interrelationship of the metric units.	No match.
Identifies, names and draws various geometric figures.	No match.
Classifies plane and solid geometric figures into various subsets using different specialized properties.	No match.
Uses correct terminology in describing the properties of geometric figures.	Match by 1 item.
Makes graphs and tables to display and compare measurement data.	No match.
Makes, reads, and interprets tables and commonly-used schedules.	Partial match